II. REMARKS

A. Introduction

Applicant has reviewed the Office Action dated March 9, 2005. In view of the amendment to claim 12 and the following remarks, Applicant respectfully submits that the claims are definite and patentable over the prior art, for at least the reasons set forth below, and are now in condition for allowance. Notice to this effect is earnestly requested.

B. Field of Invention

This invention generally relates to multi-polarization active array transmit antennas. In particular, the application describes an antenna comprising phase shifters that control the scan angle, linear polarization, and circular polarization of RF signals.

C. Pending Claims

Claims 12 and 17-21 have been amended.

Claims 1-11 and 22-24 have been cancelled.

In sum, claims 12-21 are pending.

D. Rejections And Responses Thereto

Claim 13 was rejected under 35 U.S.C. § 112, 2nd ¶ , for lack of antecedent basis for the terms "the first RF signal" and "the second RF signal." Claim 12 is hereby amended to clarify this formality and to obviate the rejection. In addition, Applicant has amended in claims 17-21 "substrate" recitations, which amendments are a matter of form and are in no way related to matters touching upon the patentability of the claims.

Claims 12, 13, 17 and 18 have been rejected under § 102(b) as being anticipated by Mohuchy. Claim 12 requires first and second substrates each having a plurality of

transmitter chips which each possess a series of phase shifters that not only control linear polarization but also controls scan angle. Mohuchy fails to discuss, much less teach, an arrangement meeting each and every of the claim terms, including the ability to control scan angle.

The present invention is a transmit tile antenna comprising a multi-element transmit active array antenna capable of transmitting two simultaneous signals with any polarization and scan angles, e.g., the inventive antenna can transmit two independent signals (beams) with linear (0 to 90°), left hand circular, or right hand circular polarizations. As shown in the exemplary embodiment of Figure 4, four substrates are stacked on the top of each other and each may be made of LTCC. The function of the substrates are as follows. The interconnect substrate contains two driver chips, bypass capacitors, RF connectors, and DC connectors, and brings RF, DC, and digital control signals to the antenna. The second substrate contains a plurality of transmitter chips, and a sixteen-way divider, and brings RF, DC, and controls signal to each transmitter chip. The second substrate controls the polarization and scan angle of the second signal and it also amplifies the second signal. The first substrate contains a plurality of transmitter chips and a sixteen-way divider, and brings RF, DC, and controls signal to each transmitter chip. The first substrate controls the polarization and scan angle of the first signal and amplifies the first signal. The radiator/balun substrate contains sixteen patch antenna and radiates two simultaneous signals (two beams). Fuzz bottom and caged via holes are use to connect the substrate together, and carry RF and DC signals from one layer to another.

In the exemplary embodiment, discussed herein for reference, the transmit tile antenna comprises a monolithic (single piece) GaAs transmitter chip that controls the polarization and scan angle of the transmitted signals as well as amplifies the transmitted signals. The transmitter chip contains a high-speed GaAs digital serial-to-parallel converter for controlling the phase shifter and attenuator circuits, two 3-bit attenuator (304 in Figure 1), two 6-bit phase shifter (305, 306, 307, 308, 3091, and 310 in Figure 1), a Lange coupler, two 90° phase shifter bit (3092 in Figure 1), and amplifiers. The transmitter chip, when connected to a pair of orthogonal radiators, is capable of generating a signal with a linear polarization angle in range of 0 to 90 degrees with any scan angle. It can also generate left and right-hand circularly polarized signals with any scan angle. The combination of two 6-bit phase shifters, two 3-bit attenuators, and a Lange coupler is used to control the linear polarization angle. Two phase shifters are for coarse adjustment and two attenuators are for fine adjustment of the linear polarization angle. The combination of two 90° phase shifter bit, and two 3-bit attenuators is used to control the circular polarization angle. Two phase shifter bit are for coarse adjustment, and two attenuators are for fine adjustment of the circular polarization angle. The combination of two 6-bit phase shifters and two 3-bit attenuators is used to control the scan angle. Two phase shifters are for coarse adjustment, and two attenuators are for fine adjustment of scan angle. Using attenuator for fine adjustment of the polarization and scan angle not disclosed in the prior art.

In general, phase shifters, attenuators, and amplifiers may be components of electronically scanned active array antennas. The phase shifter controls the phase of the

RF signal, the attenuator reduces the amplitude of the RF signal, and the amplifier provides amplification to the RF signals. The electrical performance of the active array antennas depends on how these components are configured in the array circuit architecture. These components can be configured to work as a radar active array antenna, a communication active array antenna, or a measurement system.

Mohuchy discloses a phase shifting integrated circuit chip (PSIC) as shown in Figure 2a of U.S. Pat. 5,933,108. This GaAs chip only contains phase shifters, amplifiers, analog phase bit, and digital circuits. The circuit provides phase shifting and amplification to the RF signal. Mohuchy further discloses a Reciprocal Planar Magic Tee (RPMT) that is fabricated on GaAs substrate. Mohuchy assembled four PSIC, and two RPMT chips, as shown in Figures 1 and 6, to build a microwave vector controller for controlling the amplitude and phase characteristics of the RF signal. In receive mode it may be used to measure the linear polarization angle of an incoming signal. The large circuit of Mohuchy (six GaAs chips) can only produce linear polarization and cannot produce circular polarization because of the RPMT in the front of the phase shifter. The Mohuchy circuit is not capable of scanning the RF signal. The Mohuchy circuit does not control circular polarization and scan angle of an RF signal and does not have vertical structure, i.e., a chain of GaAs chips connected together. The Mohuchy circuit does not use attenuator for fine linear polarization angle adjustment and does not support two simultaneous signals (beams).

Accordingly, Mohuchy fails to disclose, teach or suggest a circuit in which each transmitter chip comprises "a first series of phase shifters to control the scan angle and

linear polarization of a first RF signal, a first 90° phase shifter to control the circular polarization of the first RF signal, and a first means for controlling the first series of phase shifters and the first 90° phase shifter." Further, the Mohuchy reference fails to disclose, teach or suggest a circuit having "a second substrate containing a plurality of transmitter chips, connected at the output of the first substrate, wherein each transmitter chip is comprised of a second series of phase shifters to control the scan angle and linear polarization of a second RF signal, a second 90° phase shifter to control the circular polarization of the second RF signal, and a second means for controlling the second series of phase shifters and the second 90° phase shifter" as claimed in claim 12.

For at least the reasons set forth above, Mohuchy fails to disclose, teach or suggest each of the limitations of the pending dependent claims 13-21.

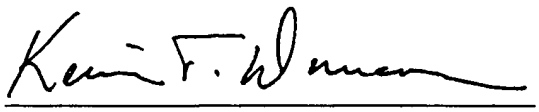
Applicant respectfully requests consideration of these claims and respectfully submits that all pending claims distinguish over the prior art.

III. Conclusion

Applicant respectfully submits that the claims as amended are supported by the specification and therefore add no new matter. Applicant further submits that the pending claims are definite and patentably distinguishable over the prior art of record and that the application is in condition for allowance and respectfully requests a notice of allowance for the pending claims. Should the Examiner determine that any further action is necessary to place this application in condition for allowance, the Examiner is kindly requested and

encouraged to telephone Applicant's undersigned representative at the number listed below.

Respectfully submitted,

Date: **September 9, 2005** By: 

Kevin T. Duncan
Reg. No. 41,495

Hunton & Williams LLP
1900 K Street, N.W.
Washington, D.C. 20006-1109
Phone: (202) 955-1500
Fax: (202) 778-2201